An Action Research Approach to Rural Living Labs Innovation

Hans SCHAFFERS[1], Javier GARCIA GUZMAN[2], Christian MERZ[3]
[1]*CKIR, Helsinki School of Economics, P.O. Box 1210, 00101 Helsinki, Finland*
Tel: +358 9431 38946, Fax: + 358 9431 38391, Email: hans.schaffers@hse.fi
[2]*Universidad Carlos III de Madrid, Avda. de la Universidad, 30, Leganes, 28911, Spain*
Tel: +34 91 624 88 57, Fax: + 34 91 624 94 30, Email: jgarciag@inf.uc3m.es
[3]*SAP AG, Vincenz-Priessnitz-Strasse 1, 76131 Karlsruhe, Germany*
Tel: +49 721 690244, Fax: + 49 721 696826, Email: Christian.merz@sap.com

Abstract: This paper examines the potential of the Living labs concept as change catalyst for rural and regional development. An action research approach is proposed as a basis for organising innovation in Living labs. The approach distinguishes between strategic and operational Living labs activities. We discuss how software development as spiral process and how architecture framework development can be integrated into action research approaches. The paper is based on the mid-term results achieved in the seven Rural Living Labs launched by the C@R project.

1. Introduction

Living Labs [1] are experimentation and validation environments of ICT-based innovation activities, characterized by the early involvement of user communities, by openness in establishing a close cooperation between developers, users and other stakeholders, and by creation of rapid learning cycles accelerating the innovation process. The Living Labs concept thus provides a concrete implementation of the well-known concept of open innovation [2, 3]. A "resource" view implies a Living Lab as bringing together people (users, designers and other stakeholders), innovation opportunities, enabling technologies and know-how (e.g. computing technologies, software infrastructure), and, in a broad sense, collaboration infrastructures, facilitating innovation. A "process view" on Living labs adds to that the particular working methods to create rapid learning and accelerate innovation.

An important ambition of the Lisbon Agenda and national policies is to increase the business value of R&D. Living Labs strategies help achieve this goal through creating open innovation environments and empowering end-users to engage in product and service development in real-life contexts. To achieve this vision, Living Labs will benefit from social sciences methodologies as well as from ICT and multi-media services to enhance collaboration infrastructures for open innovation. The process of users coming up with products and services is increasingly well documented [4], but so far few innovation and research organizations are actively trying to take advantage of it.

This paper addresses the issue how Living Labs act as change catalysts for rural and regional development and how the Action Research paradigm provides guidance to implementing Living Labs. The ambition of the Living Lab approach is to provide a mechanism to improve and change the rural innovation system, stimulating openness, systemic innovation and learning. This cannot be provided only by offering specific methods and tools to the designers or to users or even by implementing a participative design approach. A qualitative change to the existing rural innovation system is necessary. A Living Labs approach fostering open innovation and process view based on Action

Research to implement human-centric and systemic innovation may create rural innovation ecosystems that directly contribute to improving the economical and/or social conditions.

The paper is based on mid-term results achieved in seven Rural Living Labs launched by the C@R project [5]. Primarily focus is on the critical early phase of Living Labs preparation and deployment in a rural or regional innovation setting: the process of initiating, preparing and developing a Living Lab, and ensuring that it is supported by rural and regional stakeholders and embedded in the rural innovation context. The approach of C@R is to involve key regional policy, business and innovation stakeholders in Innovation Communities to actively link Rural Living Labs development to local and regional interests. Thus, "policy innovation" is part of the innovation as well, as is technical and organizational innovation.

The paper is structured as follows. Section 2 introduces the C@R project as research setting of seven Living Labs and presents approaches to phasing of Living Lab development and to addressing the policy and stakeholder involvement dimension. Practical instructions and guidelines obtained during the adaptation of Action Research approach to Living Labs are presented in Section 3. Section 4 discusses initial experiences of applying Action Research principles in the C@R Living Labs. Finally, Section 5 presents conclusions and outlook.

2. Phases and Key Issues for Living Lab Development

2.1 C@R Project: Seven Living Labs to Foster Rural Development

The C@R project aims to foster innovation in rural environments through the introduction of Software Collaboration Tools, improving rural business processes and collaboration environments, enhancing productivity of the innovation process, and thus improving rural development and quality of life. Seven Rural Living Labs have been launched to demonstrate the potential of the Living labs approach:

- Sekhukhune living lab supports innovation in procurement and logistics, stock management and knowledge sharing to enhance the retail supply chain, informal trade and entrepreneurship.
- Frascati living lab focuses on business incubation support in exploiting space technologies and precision farming.
- Homokhátság living lab concentrates on developing an agricultural collaborative working environment based on wireless networks to support collaborative production management.
- Region Åboland living lab works on innovation in public service through e-democracy tools for local government in distributed settings.
- The Vysocina living lab targets collaboration in the territorial planning and decision making process on the basis of using geo-data.
- Soria Living lab involves local entrepreneurs and emerging SMEs in creating local business in the mycological sector, tourism services and emergency management.
- Cudillero living lab develops innovative fishery management processes, in particular improving the logistics and information exchange between fishing boats and auctions.

The action research approach has been implemented in order to establish collaborative research and innovation environments in which researchers are working together in a "natural" way with rural stakeholders and users. In using this approach in the different rural living labs we aim to identify and study the different context variables that need to be taken into account to establish successful innovation environments. Emphasis of ICT-based innovation in these rural Living Labs is on the domains of life, work and leisure in rural and remote areas, including the improvement of collaboration environments and the related

business processes - not on the creation of new products and services for the mass market. Therefore, users and stakeholders of the rural Living Lab are those who are involved in creating innovation initiatives and in improving collaborative work and business processes.

2.2 *Phases and Key Issues for Living Lab Development*

Living labs development covers distinct phases of development. Although all Living Labs local situations are different, the distinct key phases are:

1. Preparation: setting in place the conditions for final success of the Living Lab, such as establishing commitment of key stakeholders and embedding the living lab in rural policies. Key activities are joint vision building, discussion of local innovation opportunities and possibly working on a business model enabling longer term cooperation between stakeholders.
2. Examples creation: demonstrating effect of innovations on work and business practice is necessary to convince skeptics or would-be followers. Limited-scale experimentation on technical and business process innovations and sharing critical information to initial users may be appropriate to create an initial user community.
3. Field experimentation. In a later phase of development, and as soon as initial examples can be shown and early adopters are able to adopt business process innovations, the conditions are improving for transition towards more extensive development, experimentation and user involvement activities.
4. Co-creative innovation. The phase of co-creation of innovative software applications is end result of Living labs development, not the beginning. At this stage there is a more extensive user community willing to actively be involved. A business model governing the operation of the Living lab as innovation environment is in place.

Developing a successful strategy for preparing, developing and implementing Living labs as innovation environments in these rural and regional settings requires local situation characteristics to be taken into account. These include the level of infrastructure and technologies, the existence of an innovation-friendly culture, and the innovation and business opportunities of interest for the particular rural environment. Moreover, local characteristics include the stakeholder interests which are related to the plans and ambitions of policy makers, business associations and user organizations. Early phase actions are to ensure that these local conditions are being addressed properly. In C@R, the local situation generally is characterized as unfavourable for innovation: the rural areas are mostly poor, infrastructure is lacking, the population is ageing and innovation culture is low-level.

2.3 *Strategies for Introducing Rural Change*

In addressing this situation, it is important to think about the launch of Living Labs as strategy of introducing change in order to overcome the difficulties of the existing local innovation system. The rural Living Labs have developed different approaches to overcome specific difficulties of involving users and stakeholders in their particular context. None have been targeting large user communities and involve large numbers of rural users in applications development. Involvement of large numbers of users in co-creative innovation activity is appropriate for products and services targeting mass markets, and relatively advanced users used to interact with such products and services. Circumstances in rural areas are much different and rural innovations are targeting specific sectors or value chains such as agriculture in Hungary, fishery in Cudillero, mycological sector in Soria, supply chains in Sekhukhune. For this type of Living Lab the value chain dimension is key. As innovation in value chains or networks is strongly determined by the interests and cooperation of key players, it is not surprising that also in rural Living Labs attention has focused on creating agreements and cooperation among key stakeholders.

Table 1: Strategies to Involve Users, Examples

Living labs User strategies	Sekhukhune Living lab	Soria Living lab	Cudillero Living lab
\Target key stakeholders (decision makers)	Marriage approach of the System of Innovation stakeholders with Infopreneur Communities [6]	Alignment of Living Labs initiatives with rural development policies and strategic objectives defined by local action groups	Asturias Region acted as Living Lab sponsor, coordinating all activities enabling introduction of ICT innovation in fishery.
Improve rural innovation culture	New service delivery introducing entrepreneurs (Infopreneurs) to overcome rural pain points (high transaction costs, bad infrastructure etc.)	Making initiatives to define new market (mycology products market) and collaborative re-design of products related to wood industry	Provision of prototypes of innovative solutions, letting end-users to test and then gather their new needs.
Create early end-user involvement in rural areas	Target individual micro-entrepreneurs that are organized in Focus Groups	The leadership and coordination of new markets and product concepts are driven by the users and innovators (i.e. mycology market)	Living Lab users are taking the leadership for the definition of new processes for making Cudillero fish market more effective and attractive
Create business models for effective partnerships	Combining aspects of social entrepreneurship, franchising and PPPs. Revenue generation by decrease in transaction costs, increase in overall turnover of products and speeding up single transaction cycles. [7]	The implementation of LEADER+ policies by ADEMA local action group required a previous definition of public-private partnership models	Creation of a legal entity with a fixed (but limited) funding integrated by public and private organizations related to the Living Lab with the competences of developing innovation projects in the scope of the Living Lab

Table 1, focusing on user and stakeholder involvement, provides a selection of strategies that were adopted in three of our rural Living Labs to ensure successful launch of the Living Lab development in the first preparatory phase. Policy related to innovation is part of the innovation environment in balance with technical and organizational innovation, and during the preparation phase of C@R, policy and other stakeholders were encouraged to become part of C@R Innovation Communities.

Regarding regional and rural development, the LEADER approach is now generally seen to be well suited to the needs not only of distressed rural areas but of all types of rural areas. The European Commission has made all European Union rural areas eligible for the LEADER+ Initiative since the period 2000-2006. In most cases, policy administrators are remote from the beneficiaries of such policies; LEADER has endeavoured to close this gap by putting programme administrators in direct contact with the "field" by shortening decision-making cycles and by providing customised support and guidance for projects, notably by setting up local teams of practitioners to coordinate the work locally.

In many cases the development of rural Living Labs requires active participation of policy makers as enablers of rural innovation activities. For instance, in Cudillero Living Lab the regional government has played the role of the Living Lab sponsor, coordinating and activating all the creation activities in order to enable the introduction of ICT innovation in the fisheries sector. Once the Living Lab is created, its coordination and leadership is moved to local social and economical organizations that configure the most important part of Living Lab stakeholders. Once this innovation setting is established, innovation activities in Living Labs proceed through iterative cycles identifying the innovation opportunities, the formulation of hypotheses which guide solutions, the development and prototyping of solutions, and the joint assessment of results and subsequent learning.

3. Action Research and Living Labs Development

3.1   Introduction to Action Research

Action Research [8] is a collaborative activity among individuals working with others in teams or communities of practice searching for solutions to everyday, real problems. It has emerged as an established, although not undisputed, research method in use in the social sciences. Action research allows practitioners to address those concerns that are closest to them, ones over which they can exhibit some influence and make change. The ideal domain of Action Research is characterized by a community where (1) the researcher is actively involved, with expected benefit for research and organization; (2) the knowledge obtained can be immediately applied, based on a clear conceptual framework; (3) the research is a (typically cyclical) process linking theory and practice. A key assumption of Action Research is that action brings understanding and insight (new knowledge).

This methodology seems to be perfectly suited for Living Labs research, where we find a situation of openness and cooperation, complex social processes, and the need to introduce changes into these processes and observe the effects during the process. Living Labs innovation implies the creation of experimental situations which enable us to intervene during the process, observe the changes brought about, and create learning situations. This could very well be integrated in the local Living Labs environments.

3.2   An Action Research Framework for Experimenting Rural Living Labs

Point of departure is the action research cycle (Baskerville [8]) consisting of the following activities cycle: (1) Diagnosing: capturing the issues and challenges, interpretation, data collection; (2) Action planning: specifying improvements and interventions, action plans; (3) Action taking: implementing the changes, continuous monitoring, providing feedback to participants; (4) Evaluation: joint evaluation of outcomes, problem redefinition; (5) Specifying learning: an ongoing process directed to the participating organisations and actors and also researchers. Using this five-phase model, the main principles to integrate the action research approach into the C@R Living Lab activities are described below.

Creation of the community partnership regarding Living Labs. The community partnership is the specification and agreement that constitutes the innovation environment. It provides the authority under which the researchers and host practitioners may specify actions. This is a very important phase for the strategic management of the Living Lab. The main activities to implement at this stage are: (1) create a rural partnership and agree on main lines of the approach; (2) develop working hypothesis about the impacts of Living Lab creation on the rural environment and rural way of collaborative innovation; (3) prepare strategy a for Living lab launch and development; (4) prepare a strategy for stakeholders and users involvement in the Living Lab.

Diagnosis of the current issues, challenges and action planning. In C@R this refers to identifying bottlenecks and weaknesses of current rural innovation processes and specifying needs for change. Diagnosis aims to develop theoretical understanding (i.e. a working hypothesis) about the nature and direction of the rural innovation system. The main activities to be carried out in this stage are: (1) Agree on the Living Lab work planning (cycles); (2) Develop working hypotheses about how and in which business process the collaboration tools will create value for stakeholders and users e.g. in enhancing productivity; (3) Agree on the plan for implementing services, components, tools, scenarios and use cases; (4) Design the experimentation approach and detailed plan to validate services and tools; (5) Conceptual definition of improvement considered in an iteration (specifically, it is essential to define scenarios to be achieved during the next year). C@R experience learns that in order to set up Living Labs experimentation and evaluation cycles,

it is important to define a cyclic work plan covering 3 months; a longer term work plan covering one year and beyond, and a stepwise introduction of the experimentation cycles.

Development and trial use of innovations. The main objectives that must be satisfied during this stage are: (1) Implement the participative, user involvement approach for co-creation and co-design of innovative products; (2) Implement the services, tools, use cases through processes of use case analysis, design, applications development, prototyping, testing, validation and training; (3) Run the use-case related participative development experiments; (4) Use the developed solutions in concrete situations.

Evaluation and joint learning. After completing development actions and trial use, the C@R researchers and Living Labs end-users and stakeholders jointly evaluate the outcomes. Evaluation includes determining whether the theoretical effects of the action were realized, and whether these effects relieved the problems. Learning ideally should be amenable to generalization in order to generate lasting effects. While the activity of specifying learning is formally undertaken last, it is in fact an ongoing process. Action failures (in terms of the immediate problem situation) are as important as, or perhaps more important than, action successes. Action should continue until the immediate problem situation is relieved. Actions that relieve an immediate problem setting are powerful evidence of the practical effectiveness of an underlying theory.

3.3 Integrating the Spiral Development Process into Action Research

The cyclic nature of the Action Research approach offers opportunities to efficiently realize end-user driven development of software platforms and applications for collaborative working environments. Within C@R an Open Service Oriented Architecture (OSOA) framework [9, 10] has been chosen and was adapted to the rural context.

Table 2: Software Development and Architecture Design Integration into Action Research

Phase	Principles
Diagnosing	Participatory identification of pain points with end users that enables co-innovators to get a full understanding of where the user comes from. Early detection of overlapping pain points and the immediate translation into potential technical synergies are vital for the design of reusable services and service orchestration mechanisms that suit the needs of different living labs in different context.
Action planning	The diagnosing seamlessly enters into a phase of use case design, Business Process Modeling and process reengineering. The integrated view gathered from end user participation ends up in the definition of an engineering target point that also takes the local context of the individual Living Lab into account. Early cycles of the project lifetime reflect a rather high level business process design that gets more and more detailed in subsequent cycles. As a next step to conceptualize the implementation of OSOA (Web) Services are designed and mapped onto the architectural layers (core service layer, orchestration and application layer).
Action taking	Software development cycles (sprints) realize rapid prototypes of different maturity depending on the level of detail of use case specification. Early cycles are characterized by simple mock ups and simulated Human Computer Interaction that are not implementing the principles of OSOA. Later cycles introduce incremental changes on User Interfaces and backend functionality compliant to open standards that enables simplified accessibility.
Evaluation	Applied end user feedback collection enables co-innovators to learn lessons for future product backlogs. Many different ways of feedback mechanisms are being used like observations, surveys, interviewing, test case execution etc. At the same time the design principles of the architecture framework are validated (e.g. open standards, service reusability) are applied.
Learning	Outcomes of the evaluation phase serve as input for the next development cycle (product backlog). Such input affects the use case redesign, service specification, Business Process Models etc. In a sense the spiral of incremental improvements eventually leads to the best fit of solution closest to the engineering target point.

The initial architectural framework is adapted incrementally according to the learning in the individual cycles of prototypical implementation. Agile development methodologies proved to be successful in standard software development.

We consider as key to success to marry agile development with the cyclic approach of action research. One prominent example of agile development management methods is called SCRUM [11]. Typically SCRUM implements monthly sprints that try to develop solutions based on distinctive requirements (determined in a so called product backlog). The setup of Living Lab experimentation allows for similar approaches as it provides the environment for continuous product backlog refinement based on explicit learning acquired in former cycles of prototypical implementation. Such a cycle again is characterized by the five phases of Baskerville. In addition to section 3, the important principles sketched out in Table 2 apply to the different phases in terms of software development and architecture design.

4.   Initial Experiences in Applying Action Research Concepts

In the second half of the C@R project, a systematic approach to monitoring and assessment of how the rural Living Labs are functioning as innovation environments will be undertaken. Some initial observations and experiences from selected Living Labs, highlighting different aspects of the action research based Living Labs approach and guiding the next phases of work, are the following.

- Sekhukhune Living Lab is strongly rooted in a representative rural African context. The living lab approach is well-grounded in developing a micro-franchise network of social entrepreneurs, running start-up service enterprises within local communities of Sekhukhune. Different approaches such as focus groups are employed to organize a cyclic development process of applications for collaborative (micro-)enterprising.

- Frascati Living Lab has established a regional user community in space technologies exploitation and regional innovation. The Living Lab activity in fact fulfills a community building role, as it has brought together various stakeholder organizations to initiate, discuss and deploy innovation activities, even extending the regional scope. In experimenting a collaborative platform for incubation support and winery management, several real-life scenarios have been developed and expanded and a cyclic development approach has been implemented in which several key organizations are involved.

- Homokhátság Living lab has developed, in close collaboration with rural stakeholder organisations (in particular farmer cooperatives) a cyclic approach to service development and testing. The approach has contributed to forming a stronger rural community. Involvement of a wider set of end-users (farmers) has been difficult so far due to hierarchical organization of the sector, but could be improved through current plans for initiating agricultural innovation communities.

- The Cudillero Living lab approach is based on involvement of key stakeholders within the fishery value network. A user community is in the process of development and a Living lab steering group has been formed, involving key stakeholders. Basic services have been proposed and tested as part of the collaborative platform. A legal entity has been created to guide Living labs work.

The set up and organisation of the Living Labs work as presented in section 3 seems to be capable to enhance capabilities for innovation but must be adapted to local conditions. In all rural Living Labs, a cyclic and spiral approach to development work has been established but in different forms. Several interdisciplinary groups have been launched for involving stakeholders and researchers with different skills, competences and profiles in the innovation process, and use case pilots have been created to accelerate development work and attract stakeholder interest.

5. Discussion and Conclusions

Implementation of action research approach contributes to a systematic and collaborative approach to experimentation, evaluation and learning. Action research also enables to strengthen the aspect of socio-technical interaction, change and learning, and to realize the involvement of the researchers along with other stakeholders in the process of innovation and change. Essential for success is to ensure that the different activities in the (cyclic) process of experimentation and evaluation are being properly addressed and monitored.

A crucial step in applying Action Research principles to Living Labs innovation consists of shaping the innovation setting, composed of all communities, end-users and stakeholders that are involved in the innovation process. This means tailoring to the social and political context, the local aims and interests, the available infrastructure, and willingness of local partners to work together. Due attention must be paid to the process of building local partnerships and commitment, to preparing the basic foundations in terms of infrastructure and attitude, and starting with limited experimenting on simple use cases in order to be able to learn more effectively. Once the innovation setting is viable, the innovation activities can be managed by means of iterative cycles of interventions, experimentations and joint learning. This implies that a rural Living Lab is evolving over time, inviting for continuous feedback and enhancements until its full promise has been achieved. Relevant feedback will be achieved only if an effective and active Living Lab user's involvement is achieved. The "user" of the living Lab consists of a wide spectre of stakeholders, not only end-users but – especially in rural development contexts - also businesses and representatives of local communities and agencies.

This research work has verified the hypothesis formulated in the introduction section, but authors are working in next research activities related to the definition of a Living Lab Capability Assessment Model in order to let Living Lab practitioners monitor and assess how our Living labs act as innovation environments and to assess the impact of such Living labs in creating value for users, stakeholders and the rural environment.

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